CENTER FOR BEAM PHYSICS SEMINAR

"Ion Acceleration with Ultra-High Intensity Lasers"

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Albert Ghiorso Conference Room (71-264), LBNL
Refreshments served at 10:20 AM

Abstract: Collimated MeV jets of carbon and fluorine ions from the rear surface of thin foils irradiated with laser intensities up to $5x10^{19}$ W/cm^2 are observed in our experiments the 100-TW laser at LULI, Paris. This is explained by hot electrons accelerated in the laser interaction region on the front side, penetrating the target and creating an electric field (~ TV/m) on the rearside which the accelerates ions by the so called Target-Normal-Sheath-Acceleration (TNSA) mechanism. The acceleration of heavy ions could be enhanced by orders of magnitude, up to 5 MeV/nucleon (~ 100 MeV), by heating the targets and thus removing the hydrocarbon contaminants supplying the dominantly accelerated protons. Two Thomson parabola detectors with SSNTDs and automated single particle counting were used to measure absolutely calibrated ion energy spectra for each present species and charge state. From the detailed spectra the acceleration dynamics and the spatial-temporal distributions of the accelerating E-fields at the rear surface of the target are inferred. For the analysis different processes like direct field ionization, collisional ionization and recombination have to be taken into account. First modeling shows that it is necessary to expand the TNSA model and take into account dynamic effects. The measured spectra show that it is possible to influence the interaction with respect to ion species and charge states and form a basis for future experiments. Especially with regard future applications like laser driven ion sources and particle accelerators, for which a direct control of the acceleration process is needed, the first results seem to be promising.

Biographical data and research interests: Manuel Hegelich studied Physics at the Universities of Siegen, the Napier University of Edinburgh and the Georg-August-Universität Goettingen working on wavefront measurements for microscope lenses, holographic interferometry and fast optical storage in Polymers. Since 1999 he worked as scientific assistant at the Max-Planck-Institute for Quantum Optics (MPQ), and as PhD student with Prof. Habs at the Ludwig-Maximilian-Universtät München. His current research interests are relativistic laser-matter interaction and particle acceleration by ultra high intensity lasers. In particular the possibilities of directed high energetic laser accelerated ions were at the focus of experiments conducted at the 100 TW Laser at the Ecole Polytechnique at Paris and on smaller scale at the ATLAS Laser at the MPQ.